Physics 131
General Physics I
Grinnell College

Homework Vb

Session V.3

1. A person throws a ball at a wall 5 m away. The ball's initial velocity is15 m/sec at an angle of 30º above the horizontal. If the ball is initially at a height of 2 m above the ground, how high on the wall does the ball hit? [Hint--first solve for the time at which the ball hits the wall.]

2. An object moves in a path given by the coordinates (x,y) such that x(t) = 3 sin(4t) and y(t) = 3 cos(4t). Calculate v by (v_x,v_y) components. What is the absolute magnitude of v? What does this path look like geometrically?

3. A two-dimensional version of the harmonic oscillator has the force rule

$$\vec{F} = -k\vec{r}$$

where $\vec{r} = (x, y)$ and $\omega = \sqrt{k/m}$. One possible allowed motion of an object subject to this force is
x(t) = 3 sin(ωt) and y(t) = 4 cos(ωt). Calculate v^2 and r^2 for this motion.

4. Following up on problem 6. The potential energy for the force law in 3 is just

$$U = \tfrac{1}{2} k r^2 .$$

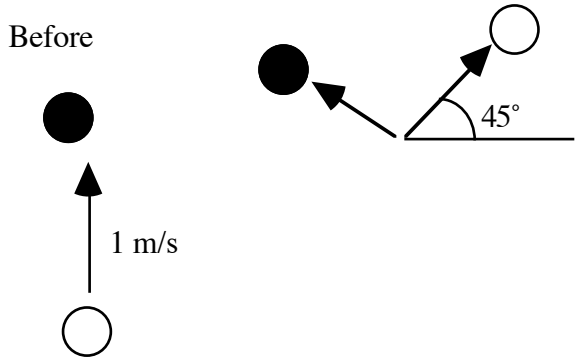
Calculate the potential and kinetic energy as a function of time for the motion in 3. Is total energy conserved?

Session V.4

5. Physics of pool, part 1. If you have played pool before, you probably know that if one hits a ball head on with the cue ball, the cue ball will nearly come to a dead stop, although not completely. Imagine a cue ball is travelling at 10 m/sec, when it hits the eight ball of equal mass, head on, which is initially at rest. The cue ball afterwards is traveling at 0.5 m/sec in the same direction as initially. How fast must the eight ball be moving? What fraction of the kinetic energy was lost in the collision?

6. Physics of pool, part 2. Consider problem 1 again. Let's define the direction of motion of the cue ball, both before and after the collision, to be the x direction. Prove using conservation of momentum that the eight ball must also be moving exactly in the x direction (i.e. have no component of velocity in the y direction).

7. Physics of pool, part 3. The cue ball is moving in the y direction at 1 m/sec, and hits the eight ball a bit off center. The cue ball ricochets off at 45˚, as shown below. If both momentum and kinetic energy are conserved in this particular collision, calculate the velocity components (v_x and v_y) of each ball after the collision.


Before
1 m/s
45°